REMARKS

Claims 1-33 are present in this application with claims 6-9, 15-17 and 28-33 remaining withdrawn from consideration in the present examination for being directed to a non-elected invention. Clarifying amendments have been made to claims 1-4, 10 and 11. Accordingly, reconsideration and allowance of the claims in the present application as amended are earnestly solicited in view of the following remarks.

Claims 1-4 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,020,592 to Liebert et al. in view of U.S. Patent No. 5,567,243 to Foster et al. or U.S. Patent No. 6,209,481 to Vesnovsky et al., claim 10 stands rejected under 35 U.S.C. §102(b) as being anticipated by Liebert et al., claims 11-14 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Liebert et al. in view of Japanese Publication No. 57-023227 to Hirata, claims 18-20, 22-25 and 27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Liebert et al. in view of U.S. Patent No. 6,196,155 to Setoyama et al., claim 21 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Liebert et al. in view of Setoyama et al. and further in view of U.S. Patent No. 6,022,446 to Shan et al., and claim 26 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Liebert et al. in view of Setoyama et al. and further in view of U.S. Patent No. 6,182,604 to Goeckner et al. or U.S. Patent No. 4,443,488 to Little et al. These rejections are respectfully traversed.

Claim 1 of the present application recites a plasma doping apparatus comprising a plasma doping chamber, a platen for supporting a semiconductor wafer and an anode located in the plasma doping chamber, a process gas source coupled to the plasma doping chamber, a pulse source for applying pulses between the platen and anode for accelerating ions from the plasma into the semiconductor wafer, and a mechanism for rotating the semiconductor wafer during plasma doping thereof. By rotating the wafer while accelerating ions therein, azimuthal uniformity variations are averaged over the surface of the workpiece. As a result, uniformity of the implanted ions by the plasma doping across the wafer is increased.

Liebert et al. is relied upon to disclose a plasma doping apparatus comprising a plasma doping chamber, a platen, an anode, a process gas source, and a pulse source. As noted in this rejection, Liebert et al. fails to disclose a mechanism for rotating a workpiece. Foster et al. is

therefore relied upon to disclose an apparatus and method for plasma enhanced chemical vapor deposition (CVD). In this CVD process, a film is deposited on a substrate 48 in which a rotating suspector 46 is used for rotating a substrate 48 at various temperatures and speeds as illustrated in Fig. 2. However, Foster et al. does not suggest or imply rotating a semiconductor wafer around is axis so that the azimuthal uniformity variations of the implanted ions are averaged over the semiconductor wafer as recited in the claims of the present application.

Alternatively, Vesnovsky et al. is relied upon to cure the deficiencies of Liebert et al. Vesnovsky et al. disclose a system for applying surface coatings to a substrate 100 such as metals, glass, catalytic, ceramics, polymerics, composites or other electro-conductive or non-electroductive materials and semiconductor chips. The rotation of a supporting platform disclosed by Vesnovsky et al. is directed to a batch processing system where a plurality of semiconductor chips or wafers are placed on a platform and the entire platform is rotated about its axis. The claims fo the present application are directed to a single wafer process where a single wafer is rotated which is not suggested or implied by Vesnovsky et al. Thereby, the CVD process of Foster et al., which deposits a film on a substrate, and the sequential ion implantation and deposition (SIID) system of Vesnovsky et al., which applies a surface coating to a substrated, are completely different processes than the plasma doping process for implanting ions into a semiconductor wafer as claimed in the present application and it would not have been obvious to one skilled in the art to combine Liebert et al. with either Foster et al. or Vesnovsky et al. As a result, the combination of Liebert et al. with either Foster et al. or Vesnovsky et al. do not suggest or imply the plasma doping apparatus for implanting ions into a semiconductor wafer as recited in claims 1-4 of the present application.

Claims 10 and 14 of the present application respectively recite a plasma doping apparatus comprising an anode having a spacing from the platen and an anode comprising two or more anode elements and actuators for individually adjusting the spacing therebetween for accelerating ions from the plasma into the workpiece. Liebert el al. fail to disclose the configuration of the anodes as recited in claims 10 and 14 of the present application. Hirata is therefore relied upon to disclose a plasma etching device in which the electric field strength and density of the reaction gas are compensated by regulating the distances between the sample electrode and the divided facing electrodes. However, Hirata is directed to a plasma etching process which compensates and regulates distances between electrodes for achieving uniform etching speed and does not disclose varying and adjusting the spacing between an anode and

platen for accelerating ions from the plasma into the workpiece as claimed in the present application. Again, the plasma etching system of Hirata is fundamentallydifferent from the ion implantation system claimed in the present application. Varying and adjusting the spacing between the anode and platen as claimed in the present application produces radially varying magnetic fields near the anode, changes the radial density profile of the plasma and improves dose uniformity of the plasma doping process is not suggested or implied in the plasma etching device of Hirata. Accordingly, it is respectfully submitted that amended claims 10-14 of the present application patentably define over Liebert et al. both alone and in combination with Hirata.

Amended claim 18 of the present application recites a plasma doping apparatus comprising a plasma doping chamber having a cylindrical geometry and a plurality of magnetic elements disposed around the plasma discharge region for controlling the radial density distribution of the plasma in the plasma discharge region to thereby control the dose uniformity of the ions implanted into the workpiece. Dependent claim 21 recites that the magnetic elements are raidally aligned to form a spoke configuration and dependent claim 26 recites that the apparatus comprises a hollow electrode and that the magnetic elements are disposed on or near the hollow electrode.

It is acknowledged in this rejection that Liebert et al. fails to disclose a chamber having a cylindrical geometry and a plurality of magnetic elements disposed around the plasma discharge region as recited in amended claim 18 of the present application. Setoyama et al. is therefore relied upon to disclose a plasma processing apparatus comprising permanent magnets 20a and 20b around the sidewall 8 of the processing chamber 2. The magnets 20a are reciprocally moved up and down by a swing mechanism while the magnets 20b are moved up and down as a group. The arrangement and movement of these magnets in Setoyama et al. generate cusp magnetic fields for cleaning with the plasma and for enhancing the etching of the inside walls of the chamber. In contrast, the distribution of the magnetic elements recited in amended claim 18 of the present application control the radial density distribution of the plasma so that the dose uniformity is controlled for the ions implanted into the workpiece. The combination of Liebert et al. and Setoyama et al. therefore do not suggest or imply the distribution and use of the magnetic elements as recited in amended claim 18 of the present application.

Shan et al. is further relied upon as it is acknowledged in this rejection that the combination of Liebert et al. and Setoyama fail to disclose magnetic elements that are radially

aligned to form a spoke configuration as recited in dependent claim 21. Shan et al. disclose spoke magnets arranged as illustrated in Fig. 4A and 4B of a plasma reactor. However, Shan et al. fail to disclose that the magnetic elements control the radial density distribution of the plasma so that the dose uniformity of the ions implanted into the workpiece is improved. Therefore, Shan et al. does not cure the deficiencies in the combination of Liebert et al. and Setoyama et al.

It is further acknowledged in this rejection that the combination of Liebert et al. and Setoyama et al fail to disclose a hollow electrode surrounding the plasma discharge region as recited in claim 26 of the present application. Goeckner et al. is relied upon to disclose a hollow electrode 300 as illustrated in Fig. 2A and Little et al. is relied upon to disclose a cylindrical anode 22 as illustrated in Fig. 1. However, Goeckner et al. and Little et al. fail to cure the deficiencies of the base rejection in the combination of Liebert et al. and Setoyama et al. Accordingly, it is respectfully submitted that claims 18-20, 22-25 and 27 patentably define over the combination of these documents and it is respectfully requested that these rejections be reconsidered and withdrawn.

Claim 5 stands rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Publication No. 01-022027 to Nakayama et al. This rejection is respectfully traversed.

Claim 5 recites a plasma doping apparatus comprising a plasma doping chamber, a plasma source, and a drive mechanism for rotating the workpiece while accelerating ions from the plasma into the workpiece during plasma doping so that azimuthal uniformity variations are averaged over the surface of the workpiece to thereby increase the uniformity of the plasma doping. Nakayama et al. is relied upon to disclose a plasma etching apparatus as illustrated in Fig. 1. Fig. 3 of Nakayama et al. illustrates another embodiment of a plasma etching device in which a driving mechanism moves electrodes up and down to obtain a uniform etching speed. However, Nakayama et al. fails to disclose a drive mechanism for rotating the workpiece during plasma doping for averaging azimuthal uniformity variations of implanted ions over the surface of the workpiece as recited in claim 5 of the present application. The plasma etching process of Nakayama et al. is fundamentally different from the plasma doping by ion implantation process recited in claim 5 of the present application. Accordingly, it is respectfully submitted that claim 5 of the present application is not anticipated by Nakayama et al. and it is respectfully requested that this rejection be reconsidered and withdrawn.

In view of these amendments and for all of the above stated reasons, it is respectfully submitted that all of the outstanding rejections have been overcome. Therefore, it is requested that claims 1-5, 10-14, and 18-27 of the present application be passed to issue.

If any issues remain unresolved, the Examiner is requested to telephone the undersigned attorney.

Please charge any additional fees or credit any overpayments to deposit account No. 50-0896.

Respectfully submitted,
Steven R. Walther, Applicant

By: ______________________

Mark A. Superko, Reg. No. 34,027
Varian Semiconductor Equipment
Associates, Inc.
35 Dory Rd.
Gloucester, Massachusetts 01930-2297
Telephone: (978) 282-5915

Docket No. VSEA 26-00